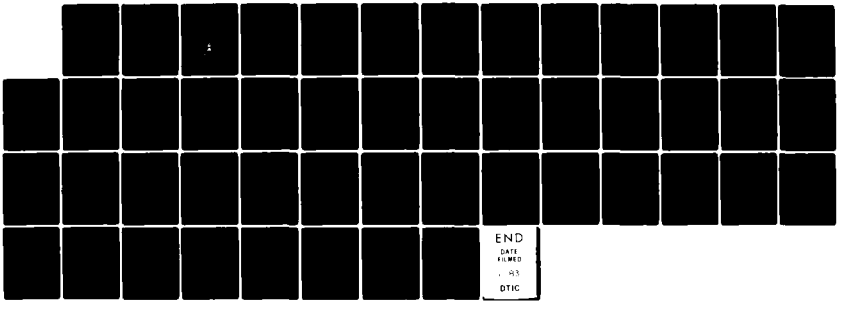
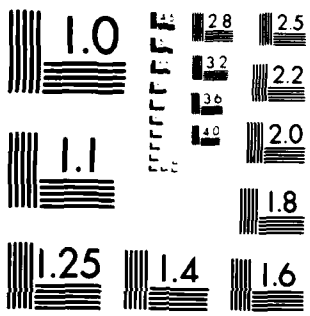
AD-A122 576 BATTALION COMBAT OPERATIONS CENTER (COC) TEST VOLUME II 1/
TEST REPORT(U) MARINE CORPS TACTICAL SYSTEMS SUPPORT
ACTIVITY CAMP PENDLETON.. C D STEPHENS 08 FEB 82
UNCLASSIFIED MCTSSA-22TO01/U-TRP-01 F/G 15/3 NL





UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(3)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: MCTSSA DOCUMENT NO. 22T001/U-TRP-01	2. GOVT ACCESSION NO. AD A122576 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): BATTALION COMBAT OPERATIONS CENTER (COC) TEST VOLUME II - TEST REPORT.	5. TYPE OF REPORT & PERIOD COVERED: TEST REPORT
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Capt C.D. Stephens USMC	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Marine Corps Tactical Systems Support Activity, Marine Corps Base, Camp Pendleton, CA 92055	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: Marine Corps Development and Education Command, Quantico, VA 22134	12. REPORT DATE: 8 Feb 1982
	13. NUMBER OF PAGES: 52
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): Marine Corps Tactical Systems Support Activity, Marine Corps Base, Camp Pendleton, CA 92055	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Approved for Public Release; distribution unlimited

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

COMMAND & CONTROL	COMMAND POST EXERCISES
INFANTRY	TEST PLAN
BATTALION	SCENARIO
AUTOMATED AID	DATA ANALYSIS

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This document reports the results of a test conducted under a test plan published as Volume I. Results for effectiveness and utility measures are presented and discussed in detail. It is concluded that the baseline four workstation mix is excessive for offensive operations at the battalion level. A discussion of the three and two workstation alternatives is presented.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

S/N 0102-LF-014-6601

UNCLASSIFIED

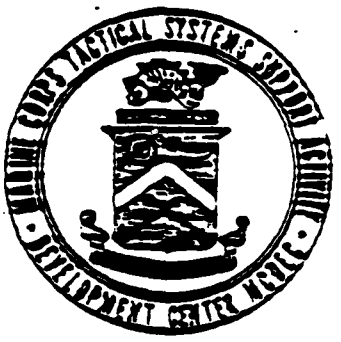
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

MCTSSA DOCUMENT NO.
22T001/U-TRP-01

BATTALION COMBAT OPERATIONS CENTER (COC) TEST

VOLUME II

TEST REPORT



MCTSSA

MARINE CORPS BASE
CAMP PENDLETON, CA 92055

8 FEBRUARY 1982

Battalion Combat Operations Center (BCOC) Test

Volume II

Test Report

Prepared by:
Capt C. D. STEPHENS USMC

Reviewed by:
Maj D. P. AMIOTTE USMC

ABSTRACT: This document reports the results of a test conducted under a test plan published as Volume I. Results for effectiveness and utility measures are presented and discussed in detail. It is concluded that the baseline four workstation mix is excessive for offensive operations at the battalion level. A discussion of the three and two workstation alternatives is presented.

3 February 1982

Analysis Section
Tactical Systems Development Branch
Marine Corps Tactical Systems Support Activity
Camp Pendleton, California

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1
INTRODUCTION

The battlefield of the future will be characterized, in all likelihood, by a higher degree of complexity and a faster tempo than that experienced in past conflicts. In order to be ready for such a taxing environment the Marine Corps has defined a set of requirements for an automated command and control system. The system, known as MTACCS (Marine Tactical Command and Control System), will exploit the advances made in electronic technology in order to assist the Marine commander and his staff at all levels. A primary goal of the system is to be responsive to the informational needs of the commander and his staff. The MTACCS will provide information which is accurate and provide it in a timely manner, thus enabling the commander and his staff to more effectively coordinate combat resources.

The design and implementation of the MTACCS raises many questions. One of those questions involves the amount of automation needed at the infantry battalion level. Too little automation would not enable the battalion commander to take full advantage of the system. Too much automation would exact an expensive payment from the battalion commander in the form of an unneeded computer hardware overhead.

The overall aim of the Battalion Combat Operation Center (COC) Test was to investigate how much or how little of MTACCS should be allocated to the infantry battalion. The scope of the test, however, was limited to infantry battalion offensive operations.

It is envisioned that, at the battalion level, human interface with the MTACCS will be via automated work stations. Desired information in a graphic or textual form can be received, transmitted, displayed, stored, retrieved, printed, created, analyzed or correlated by virtue of operator interaction in a user tolerant fashion. The question is, just how many of these automated work stations are needed by the infantry battalion for offensive operations and how should they be split up among the intelligence, operations and fire support functions.

Section 2 describes the test and section 3 presents the results. Section 4 discusses the results presented in section 3 then arrives at conclusions and recommendations.

SECTION 2
DESCRIPTION

2.1 PURPOSE

The stated purpose of the Battalion COC Test was "to determine if a proposed automated work station mix is excessive for the control of Infantry Battalion offensive operations." The approach used was to examine a proposed work station mix as a baseline and three reduced mixes as alternatives. It was reasoned that if any of the reduced mixes performed as well as the baseline, it would tend to indicate that the baseline was excessive.

2.2 PROCEDURES

The Battalion COC Test consisted of twelve iterations, each consisting of a command post exercise (CP Exercise). The CP Exercises were conducted against four scenario variations from the MTACCS-88 scenario. Each variation involved a coordinated attack with two battalions on-line. The staff of one of the attacking battalions was portrayed by a team of four officers. Each team consisted of an operations officer (S3), his assistant (S3A), an intelligence officer (S2) and a Fire and Air Support Coordinator (FASC). In all, there were four teams for a total of sixteen test participants. Each test participant was a Marine officer from the First Marine Division and was either currently assigned to the billet he portrayed on the test or had recent experience in that billet.

The scenario for each iteration began just prior to crossing the line of departure and ended two hours later, just before the final objectives were seized. During an iteration each test participant team, along with trained enlisted operators, worked together as a battalion COC staff. They received stimuli from one of the choreographed scenarios and had to monitor the attack, coordinate fire and aviation support, satisfy the information requirements of higher headquarters, perform intelligence functions, communicate, and keep records. They were not tasked with developing plans for future operations nor were they tasked with coordinating naval gunfire.

The independent variable for the test was the automated work station mix. Four different mixes were used (Table 2-1). The baseline mix (Mix A) consisted of four automated work stations; one for intelligence, one for

operations, and two for fire and air support. Two mixes (Mix B and Mix C) consisted of three automated work stations. Mix B had one for intelligence, one for operations, and one for fire and air support. Mix C had two work stations for fire and air support but only a single work station to handle the intelligence and operations tasks. The fourth mix (Mix D) consisted of two automated work stations, one to handle the intelligence and operations tasks and one to handle fire and air support.

Table 2-1. WORK STATION MIXES

MIX	S2	S3	FASC
A	1	1	2
B	1	1	1
C	1		2
D	1		1

Each test participant team was involved in four CP Exercises (iterations). Each exercise was conducted against a different work station mix-scenario variation combination. The four mixes were presented to each of the teams in a different order, with the first iteration for each team being a practice iteration to familiarize the test participants with the system and with working as a team. Data was not collected during the practice iterations and they were not considered part of the test. A full morning or afternoon was devoted to each iteration, both test and practice. Prior to their practice iteration, each team received a half-day of orientation (which included familiarization with the system). In addition, a half-day was used to debrief each test participant team after their last test iteration. This made a total of three days each team was involved in the test.

Complete details of the test design, structure and procedures can be found in the "Battalion COC GTF Validation Test Plan" (MCTSSA, Document Number 22T001/U-TR-01 9 October 1981).

2.3 EFFECTIVENESS AND UTILITY

The Battalion COC Test had two types of objectives; effectiveness evaluations and utility assessments. An effectiveness evaluation is objective in nature whereas a utility assessment involves human judgement and is primarily subjective.

Effectiveness evaluations involve measurements of observable phenomena and produce numerical results which are directly obtainable. Four effectiveness indicators were measured during the Battalion COC Test:

- The proportion of fire support requests that were correctly handled
- The mean time to process 81 mm mortar calls for fire
- The proportion of items of combat information correctly handled
- The proportion of required data base entries made.

Utility assessments involve elicitation of test participant appraisals and do not always yield quantitative results. In those cases where quantitative results are obtainable it is usually through indirect means. During the Battalion COC Test, utility indicators which were numerically quantified included:

- Battlefield perception scores
- Ability to control data
- Ability to process data
- Ability to exploit data
- Overall information system utility
- Two-at-a-time mix comparisons.

Qualitative critiques from the test participants were acquired during the debrief sessions using a structured interview technique.

An effectiveness evaluation can reveal, perhaps, that item X can perform a task faster than item Y. A utility assessment from an experienced, knowledgeable test participant, however, can ascertain whether or not item X can better enable him to accomplish his mission than item Y.

2.4 GENERALIZED TEST FACILITY. The capabilities of the automated work stations were simulated by MCTSSA's Generalized Test Facility (GTF), which also controlled the real-time scenario including message traffic, real-time movement of friendly units, and graphics presentation.

The GTF consists of ten automated work stations. Each work station consists of two video displays, one for text with an alphanumeric keyboard and one for color graphics with a joystick and a 16 function keypad. Although a GTF work station does not physically resemble the hardware envisioned for MTACCS, it can be configured to simulate some of the key automated software capabilities which are under consideration for inclusion into the MTACCS. One of the capabilities simulated for the Battalion COC Test was representing friendly position and movement information by having the standard military symbology for those units actually move across a map background in near real-time. Tactical control measures were also displayed against the same map background and were changed as the situation changed. Other automated capabilities simulated included digital message handling, a distributed data base and integrated fire and air support algorithms.

A more detailed description of the GTF can be found in the brochure entitled "MCTSSA's Generalized Test Facility" (MCTSSA, 1981).

SECTION 3
RESULTS

3.1 GENERAL

This section describes the measures and the numerical results used to satisfy the objectives stated in Section 2. The test plan specified a statistical test of the hypothesis that no difference exists between the work station mixes in the various effectiveness measures. For the purposes of this report, a statistically significant difference occurs when this hypothesis can be rejected with a probability of being wrong (Type I Error) of 0.1 or less.

3.2 EFFECTIVENESS RESULTS

Two measures were used to evaluate effectiveness in processing calls for fire. They were the proportion of specified fire support requests that were processed correctly and the mean time to process 81 mm mortar calls for fire. The results for these measures are contained in Tables 3-1 and 3-2 respectively.

A statistically significant difference was evident in mean time to process 81 mm mortar calls for fire (Table 3-2). Further investigation reveals that the difference in the times between work station Mixes C and D is prominent. No statistically significant difference occurred between any of the work station mixes for proportion of fire support requests handled correctly (Table 3-1).

The measure used to evaluate effectiveness in processing combat information was the proportion of controlled items of combat information that were passed to subordinate units. The measure used to evaluate effectiveness in maintaining a data base was the proportion of specified scenario items of information that were entered into the data base before a specified cut-off time. The results of these measures are contained in Tables 3-3 and 3-4 respectively. There are no statistically significant differences between the work station mixes in either of these measures.

Appendix B contains a more detailed explanation of the statistical analysis used on the results shown in Tables 3-1 through 3-4.

Table 3-1. Proportion of Specified Fire Support Requests Correctly Handled

	WORK STATION MIX			
	A	B	C	D
	.67	.67	.33	.33
	.67	1.0	.67	.67
	1.0	1.0	.67	1.0
Mean	.78	.89	.56	.67
Std. Dev.	.19	.19	.20	.33

Probability of Type I Error = .44

Table 3-2. Mean Time to Process 81 mm Mortar Calls for Fire (minutes)

	WORK STATION MIX			
	A	B	C	D
	.813	.833	1.93	.611
	.667	.889	1.11	.714
	.944	.833	1.06	.833
Mean	.808	.852	1.37	.719
Std. Dev.	.14	.03	.49	.11

Probability of Type I Error = .06

Table 3-3. Proportion of Combat Information Passed

	WORK STATION MIX			
	A	B	C	D
	0	.25	0	.5
	.75	.5	.75	.5
	.25	.5	0	.5
Mean	.33	.42	.25	.5
Std. Dev.	.38	.14	.43	0

Probability of Type I Error = .45

Table 3-4. Proportion of Data Base Entries Made

	WORK STATION MIX			
	A	B	C	D
	.5	.4	.6	.2
	.7	.6	.5	1.0
	1.0	.9	.8	1.0
Mean	.73	.63	.63	.73
Std. Dev.	.25	.25	.15	.46

Probability of Type I Error = .18

3.3 UTILITY RESULTS

Four measures were used to assess information system utility. One measure used was the score received by the test participants on a quiz administered during each test iteration. The scores are shown in Table 3-5; again there is no significant difference between the mixes. Appendix B contains a more detailed explanation of the statistical analysis used on the results shown in Table 3-5.

Another measure used to assess information system utility was a questionnaire administered to the test participants after each iteration. It contained four questions which asked the participant to categorize the mix used in that iteration with respect to controlling data, exploiting data, processing data, and overall information system utility. Their categorizations are shown in Tables 3-6, 3-7, 3-8 and 3-9. Figures 3-1 and 3-2 are graphical representations of interval scale values derived from the test participant categorizations.

Table 3-5. Battlefield Perception Scores

	WORK STATION MIX			
	A	B	C	D
	5	4	5	6
	7	8	5	6
	7	8	6	6
Mean	6.3	6.7	5.3	6
Std. Dev.	1.1	2.3	.6	0

Probability of Type I Error = .69

Table 3-6. Test Participant Categorization of Ability to Control Data

QUESTION: "How easy was it for you to get accurate data from this Work Station Mix?"

TEST PARTICIPANT BILLET

CATEGORY	S3	S3A	S2	FASC
Very Easy		A B	B	B C D D
Rather Easy	AA BBB CC D	AA BB C C C DD	AAA BB C C D	AA B C C D
So-So	A D D	D	D	A
Rather Difficult	C		C . D	B
Very Difficult				

Table 3-7. Test Participant Categorization of Ability to Exploit Data

QUESTION: "How easy was it for you to use the data provided by this Work Station Mix to accomplish your mission?"

TEST PARTICIPANT BILLET

CATEGORY	S3	S3A	S2	FASC
Very Easy	A B	B	A B B B	B C D D
Rather Easy	A B B C D D D	A A BB C C C DD	A A	A A B CC D
So-So	CC	A D	CC D	B
Rather Difficult	A		C D	A
Very Difficult			D	

Table 3-8. Test Participant Categorization of Ability to Process Data

QUESTION: "How easy was it for you to process (store, display and disseminate) information?"

TEST PARTICIPANT BILLET

CATEGORY	S3	S3A	S2	FASC
Very Easy	B D	B	AA BB	B C D
Rather Easy	A A B B C D C C DDD	A A A BB C C DDD	A B C D C DD	A A B C DD C D
So-So	A C D			C
Rather Difficult		C	C D	A B
Very Difficult	C		C D	

Table 3-9. Test Participant Categorization of Information System Utility

QUESTION: "Considering your responses to the previous questions, how do you rate the overall capability of the Mix you just used to perform as an information system?"

TEST PARTICIPANT BILLET

CATEGORY	S3	S3A	S2	FASC
Excellent	B B	B	AA BBB	B C D
Good	AA B C D D	AAA BB CC DD	A C D	AA B C D D
Only Fair	A CC D		C	C
Poor		C D	D	A B
Very Poor			C D	

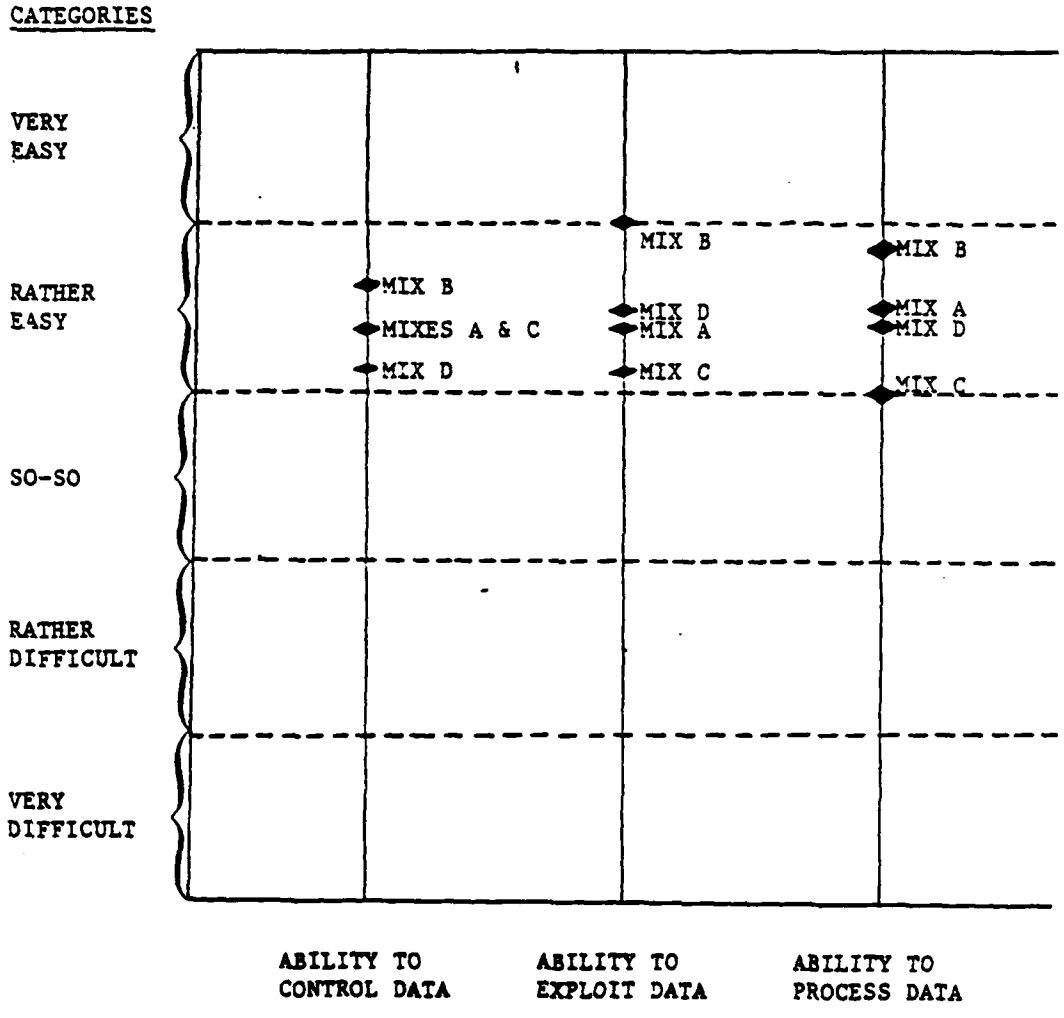


Figure 3-1. Interval Scale Representation of Test Participant Categorization of Controlling, Exploiting and Processing Data.

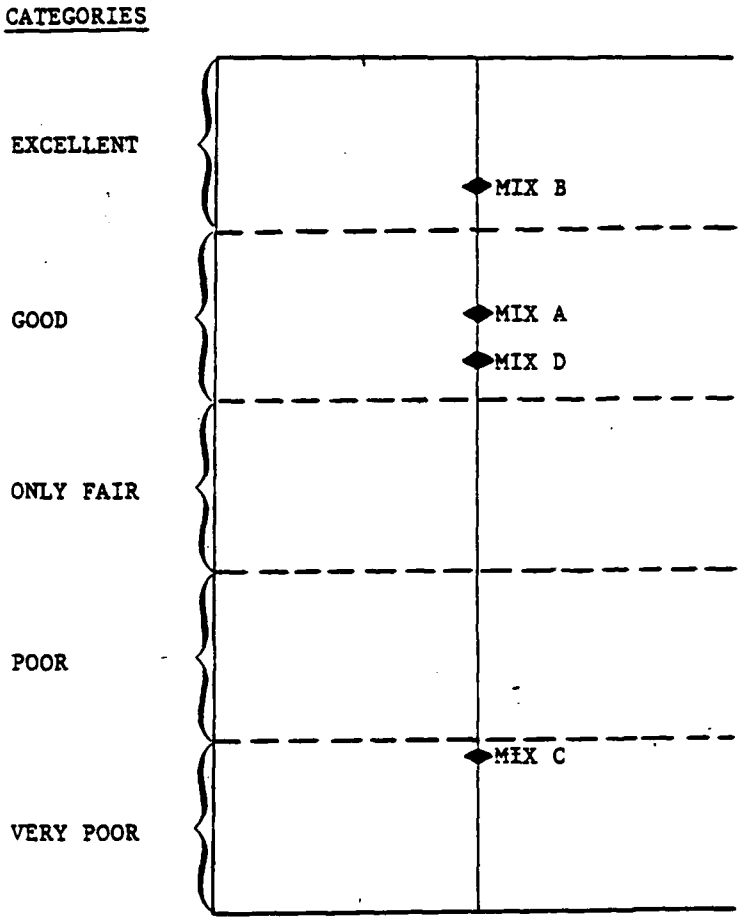


Figure 3-2. Interval Scale Representation of Test Participant Categorization of Information System Utility

On the questionnaire a fifth question appeared which was worded as follows: "Compare this work station mix with the work station mix used in the test situation just before this one. Which work station mix would you rather use?" The comparison responses are contained in Table 3-10. A scaling technique was used to produce the interval scale values shown at the bottom of the table which give a relative ranking of the mixes based on the comparison responses. A statistical test rejected the hypothesis that the test participants were inconsistent in their comparisons with a .01 probability of being wrong.

Table 3-10. Test Participant Preferences in Two-at-a-Time Comparisons

COMPARISON	S3	S3A	S2	FASC
A, B	A A A	A A A	A A *	A A B
A, C	A A A	A A A	A A A	C * *
B, D	B B B	B B B	B B B	B * *
C, D	C C D	D * *	* * *	C D D

* No difference

Interval Scale Values

Mix A - 3.39

Mix B - 2.05

Mix D - .17

Mix C - 0

The final measure used to evaluate information system utility was qualitative. After each test participant team completed all of its test iterations, a half-day was devoted to a structured interview debrief. The results of the debriefing sessions are summarized in Appendix A.

Further details concerning the analysis methodology and statistical techniques can be found in the test plan.

SECTION 4
DISCUSSION

4.1 EFFECTIVENESS EVALUATIONS

The results of the four effectiveness measures were presented in Tables 3-1 through 3-4. In three of the four measures (fire support requests, combat information and data base entries) the null hypothesis of equal effectiveness among the mixes could not be rejected. This certainly seems to indicate that, the baseline work station mix (Mix A), consisting of four work stations, is excessive. Statistically, we have shown that the reduced mixes may perform as well as, if not better than, the baseline. On the other hand, we have not shown, to a statistically significant degree, that the alternative mixes are as effective as Mix A. Statistics aside, however, a thoughtful examination of the results of the three measures in question (Tables 3-1, 3-3, and 3-4) reveal no hint of a consistent dominance by work station Mix A. In fact, Mixes B and D appear most effective and Mix C appears least effective.

The fourth measure, time to process 81 mm mortar calls for fire (Table 3-2) presents a different situation and a surprising twist. The null hypothesis of equal effectiveness among the mixes has actually been rejected. The surprising twist is that the statistically significant difference is not that Mix A is more effective than the other mixes but that Mix D is more effective than Mix C. This is surprising because 81 mm mortar processing is a fire support effectiveness measure and two work stations are allocated to fire support in Mix C whereas Mix D allocates only one. Table 3-2 tells us that fire support processing is statistically more effective with one automated work station than it is with two. Moreover, another thoughtful, non-statistical examination of the other three tables reveals that it seems to be the case that those mixes which allocate only one work station to fire support are generally more effective than those which allocate two.

It appears that, as far as effectiveness is concerned, work station Mix A is excessive. A reason it is excessive could be that Mix A allocates two work stations to fire and air support instead of one. The most effective mix in terms of the measured attributes would therefore be Work Station Mix B. Work Station Mix B performs at least as well as, and perhaps better than, Work Station Mix A but requires one less automated work station.

4.2 UTILITY ASSESSMENTS

4.2.1 Quantitative

After examining the effectiveness results it comes as no surprise that even though there are no statistically significant differences among the Battlefield Perception Scores (Table 3-5), Mix B had the highest scores and Mix C had the lowest. The interval scale representations of test participant categorizations in Figures 3-1 and 3-2 also place Mix B on the top and Mix C on the bottom. It may be said that the test participant categorizations displayed in Figures 3-1 amd 3-2 are biased inasmuch as each test participant team had only one member (out of four) directly concerned with fire support. Examination of Tables 3-6 to 3-10 reveals that such is not the case.

In the Test Participant Categorizations (Tables 3-6, 3-7, 3-8, and 3-9) the FASC Officers categorized Mix D higher than Mix C. In the Two-at-a-time Direct Comparisons (Table 3-10) the FASC Officers chose Mix D over Mix C. As can be seen in Table 2-1, Mixes C and D form a natural fire support comparison because in both cases only one work station is available for operations and intelligence whereas Mix C has two work stations for fire and air support and Mix D has one station for fire and air support. By the same token, Mixes A and B also form a natural fire support comparison. Both mixes have two work stations for operations and intelligence whereas Mix A has two work stations for fire and air support and Mix B has one. Tables 3-6, 3-7, 3-8, and 3-9 reveal that the FASC Officers also categorized Mix B higher than Mix A. Only in the two-at-a-time comparisons do the FASC Officers show a preference for Mix A over Mix B. It appears, statistically, that for fire and air support a single automated work station is preferred to two.

Tables 3-6 to 3-10 reveal that the other members of the test participant teams (S3, S3A and S2) did not prefer a single automated work station to two. For intelligence and operations functions Mixes A and C form a natural comparison as do Mixes B and D. In the categorizations and the two-at-a-time comparisons the operations and intelligence test participants were consistent in choosing Mix A over Mix C and Mix B over Mix D. The only exception is in the perceived ability to exploit data (Table 3-7). The assistant operations officers (S3As) categorized Mix C slightly higher than Mix A.

4.2.2 Qualitative

The structured interviews (Appendix A) revealed a desire for more, rather than fewer work stations; equipment weight was not viewed as a problem. The structured interviews made it quite clear that if only one work station was available for operations and intelligence, there would be no sharing. It would be an operations work station. The functions of operations and intelligence are too dissimilar for work station sharing to be feasible. It was felt that the operations tasks could adequately be performed on a single work station.

Although the automated capabilities enabled the operations and fire support officers to perform their current tasks in a more efficient manner, the intelligence officers stated that an automated work station would enable them to do much more than they are currently doing. One intelligence officer expressed a doubt as to the desirability of doing more intelligence work at the battalion level.

In the structured interviews the FASC Test Participants expressed a desire for at least two, if not more terminals. The reason given in the structured interviews was that although they were able to adequately handle the fire and air support tasks with one terminal, a real-life situation will be more intense than the scenario used for the test. It is possible, however, that the automated capabilities simulated by the GTF improved the fire support handling capabilities of the FASC Test Participants to the extent that they did not realize the intensity of the scenario as they would have if they had been operating manually. The scenario contained ten 81 mm requests, three medevacs, three tactical air requests, nine artillery requests, a helo lift and an LZ prep all within one hour and forty minutes. It should be pointed out here that there may be a relationship between the number of work stations required and the number of FASC users. A single FASC Officer, as we had in the Bn COC Test, may not have been comfortable and efficient monitoring two work stations. A single work station, therefore, seems adequate for fire and air support for infantry battalion offensive operations.

4.2.3 Assessments

The battlefield perception scores (Table 3-5) and test participant categorizations (Figures 3-1 and 3-2) rank Mix B is the best followed by Mix

A. The two-at-a-time comparisons (Table 3-10) and structured interviews (Appendix A) rank Mix A as the best followed by Mix B. The overall utility assessment could then rank Mixes A and B as equal in utility. In that case, Mix B would be the preferred mix because it requires one less automated work station.

4.3 MAP BACKGROUND

It should also be reported that, during the test, only the intelligence officers used the map background to any appreciable extent. It is not entirely clear whether the other officers did not use the map background because a map background is a superfluous capability or because the map background simulation capability of the GTF lacked the necessary clarity. It is perhaps a matter for further investigation inasmuch as deleting the requirement for a map background on the battalion level could result in potential hardware and software savings.

4.4 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that for infantry battalion offensive operations and under the conditions of this test, Work Station Mix A is excessive because Work Station Mix B is at least as effective and possesses at least the same amount of utility as does Work Station Mix A.

It is recommended that further testing be done to evaluate the effectiveness and assess the utility of having a map background on automated work stations being developed for MTACCS and to investigate the impact of planning functions on the resource requirements at the battalion level.

APPENDIX A

STRUCTURED INTERVIEW SYNOPSIS

This appendix is a qualitative summation of test participant comments on issues concerning fire support requests, combat information, and information system efficiency.

(Based on Structured Interview format TAB 15 to Appendix C of Bn COC Test Plan.)

Listed below are structured interview issues presented to each of the four teams at the conclusion of their respective test phases. Following each issue or question are the test participant responses, comments, and observations.

Those issues, questions, or areas of concern voiced by the test participants not categorized into the originally structured format are also included and complete the interview data necessary to satisfy the test objective.

1. Issue: How many automated work stations does the Infantry Battalion need in the offense? Why?

Test Participant Responses, Observations, Comments:

Tm 1: Work Station Mix B is best (1/S-3, 1/S-2, 1/FASC). The S-2 absolutely has to have his own screen in defense. A real situation would have tripled the message traffic contained in the scenario. The FASC needs two terminals. If voice had been available we would not have used the digital communications. Since the S-3 normally outranks the S-2, if the terminal is shared, the S-2 will get very little time.

Response time slowed as the number of terminals increased. More information needed in the defense as opposed to the offense. Advantages to sharing a work station such as easier passing of information between the S-2 and the S-3, but disadvantages far outweigh the advantages. The S-2 needs his own terminal.

Tm 2: Four work stations are needed. The S-2 and the S-3 cannot work on the same system. The same is true for the defense. The FASC needs two work stations and the ability to selectively call up graphic overlays immediately when needed.

Clutter was a serious problem. One screen and a paper map would not suffice for the FASC. The S-2 used and needed the map background. The number of work stations needed for the defense will be the same as for the offense.

The mission could be accomplished with two work stations. If three were available, the extra one should go to the FASC. The S-2 and the S-3 sharing a console is totally unsatisfactory from the S-2's viewpoint.

Tm 3: The ideal mix would be four work stations, regardless of the weight. The Bn CP will not be walking anyway.

If held to only three terminals, the S-2 and S-3 would share a terminal and give two to FASC, but four would be the ideal. The S-2 needs his own terminal.

During the test the FASC functioned well with only one terminal but felt that he needed two because the scenario did not place a heavy burden on fire support. One terminal could easily become overburdened.

The FASC used two terminals interchangeably between different tasks in order to perform more than one function at the same time. He did not assign specific tasks to a particular terminal.

More terminals are needed in the defense than in the offense. Two or three terminals could not handle a defensive situation.

Four terminals are ideal, but if given only three terminals and an amphibious setting, the initial distribution would be one

for the S-3/S-2 and two for the FASC. For later operations ashore, perhaps one terminal could be taken from the FASC and given to the S-2. The FASC generally has priority but the S-2 definitely needs a terminal. The S-2 and the S-3 can separately better exploit the information management aspects of the system and the battalion is better able to keep every one informed when the S-2 and the S-3 are not sharing a terminal.

Aboard ship and during initial phases of an amphibious operation, the S-2 is relatively knowledgeable as to enemy situation. As the situation ashore develops however, the enemy situation is changing and the S-2 needs to keep up.

Weight is not a factor (concern), the Bn CP will not be walking.

Neither FASC nor S-3 missed voice communications. Voice communications are not needed at the battalion level. Digital communications are better and more effective than voice communications.

Tm 4: Three or four work stations would be ideal, preferably four. If the COC has systems like this, the S-1/S-4 would also need similar systems, complete with maps and graphics. If we had to make do with only three terminals, the FASC would only get one terminal.

The FASC would like to have three terminals; one each for 81 mm mortars, air, and artillery. With only two terminals, air and artillery would be on one terminal, whereas Naval gunfire and 81 mm mortars would be on the other terminal.

This automated system would not do away with any billets.

The <u>ideal</u> COC would have five terminals, 1/S-2, 1/S-3, 3/FASC. Perhaps an additional one or two for admin and logistics. The reason the FASC needs so many terminals is because of the need

to reduce symbology clutter. A secondary reason is to be able to handle more missions than the scenario called for.

If the S-3 and S-2 had the same overlay call-up capability, coupled with automated warnings or signals when certain events took place (such as phase line or boundary crossings), then perhaps the COC could function with four terminals.

The S-2 and S-3 should never have to share the same terminal. Also the S-2 terminal should be close enough so S-3 could look at both screens.

If push came to shove, the S-2 would have priority over the TASC for an extra (fourth) terminal in an initial three-terminal situation.

2. Issue: What did you like most about an automated COC? Why?

Test Participant Responses, Observations, Comments.

Tm 1: Automation was perhaps of some use, but the scenario was too limited to realy tell.

For the S-2 functions, automation provided a big plus, particularly in the areas of message handling and data base lookup. We can do much more in the area of real intelligence work than we currently do.

The potential to have such a large amount of information immediately available is a large positive factor.

The ability to selectively call up and/or erase overlay items is a desired capability.

Readily available information is a positive factor.

Tm 2: The ability to selectively call up graphic overlays is a definite need.

There was no unnecessary symbology, it was all needed. Grid lines are needed, the map background is not necessary.

A better information handling system is desperately needed, this may be the answer. It is not going to help command and control very much, however. Instant access to information is the biggest selling point. We did not feel isolated from the battlefield. Unit location is a strong selling point.

Message handling and reliability were much, much better than the current system and is a vast improvement even without the fancy graphics.

The GTF could be used as a training facility.

Tm 3: The S-2 was very favorably impressed with the flow of message traffic, as were the other participants. They <u>all</u> felt that the increased message handling ability was the most desirable aspect of the system. The graphics and PLRS are "nice-to-haves." Communications was seen as the key and most important part (attribute) of the system.

This system will serve a great need if it can reduce communications rhetoric.

Tm 4: We really liked the rapid dissemination of information. We were easily available to keep the entire battalion appraised.

The S-2 really liked the friendly real-time positioning information but wanted the ability to put his own graphical information on the screen. He feels that too much raw information (as opposed to intelligence) was sent to the battalion.

The FASC was impressed by gun-target lines, mortar positioning visible on the screen and the S-3 was fond of the data base concept and felt that the information contained therein was also vital for S-4 (logistical) functions. Other capabilities listed were: aircraft tracks

gun target lines

recall and storage of data

message readdressing and forwarding

We would like to have the data base automatically adjust as casualty and ammo reports come in and give a warning when threshholds are reached.

The system increases timeliness, thereby giving the S-2 more "thinktime" instead of busy work. As far as the S-2 is concerned, timeliness is all-important.

3. Issue: What did you like least about an automated COC? Why?

Test Participant Responses, Observations, Comments.

Tm 1: The S-2 wants the capability to put graphics on the screen (of his own choosing).

We did not use the map background. It made it too hard to see.

Enlisted Marines at the battalion level do not have the GCT to operate such a system.

Graphical and overlay information we were familiar with was deleted from the screen.

Did not use the map background at all for coordinating fire support. The map is only needed for fire support planning.

The FASC would like a fire support status board type display available.

Automated assisted targeting solely through interaction with the screen graphics is very much desired.

Given such an automated system, we would still need the manpower and resources to maintain an acetate map board.

The symbology does not really indicate the location of a unit or its formation on the ground. This is confusing for coordinating fire support and renders the system untrustworthy.

Clutter was a big problem.

All the information needed for fire support causes too much clutter when all displayed at once.

The automated COC limits you to only one source of information, the system itself.

Tm 2: Clutter was a serious problem. One screen and a paper map would not suffice for the FASC.

The response time was poor; too slow.

Being restricted to one color is not that much of a factor.

A manual backup will be needed: A kneeboard map should suffice.

Situation maps with acetate are also needed.

Voice communications were sorely missed. A voice communication system is needed as a backup.

The S-3 did not use the map.

The FASC did not use the map.

The S-2 used and needed the map.

Grid lines are needed, the map background is not necessary.

A data base retrieval system which keys on the item is much better than the encyclopedic look-up which was used on the test. This is needed for all items in the data base, not just friendly information or enemy information.

A manual backup will definitely be needed.

Too much information goes up to regiment. Too many people have access to your business. Artillery fires should not go to regiment. Regiment should only be concerned with the general support batteries.

Clutter is a serious problem.

Tm 3: Neither the FASC nor the S-3 missed voice communications. Voice communication is not needed at the battalion level. Digital communication is better than voice communication and is more efficient. The spectre of higher commanders "looking over the shoulders" of subordinates is a reality with this system. Since this system provides more information to all levels, perhaps there will be restraints on "field grade squad leaders." Higher commanders usually get excited over a shortage of information.

There should be no S-2 and S-3 infighting over the use of a single terminal because watch officers, not the actuals, will be on the station (professionalism should prevail).

Officers should operate the terminals, not enlisted. Watch officers could operate the machines. However, there would be no reduction in the number of CP personnel due to the myriad other tasks to be performed, including CP security. No additional people would be required because of the system.

The FASC used grid lines on a white background because of symbol congestion. He did not use a map.

Marine Corps-wide computer brevity codes would be needed with a system such as this.

The S-3 did not use the map either. They all could perform their functions without the map background if paper maps were available. The S-2 and S-3 would like a clear map background. The FASC felt the map background even with a clear map was unnecessary. Selective call-up of map information would have been desirable. So would features such as automated terrain compartmentalization and terrain altitude topping.

The ability to selectively and responsively call up and erase overlay information on the screen was very much desired by the FASC. Timely responsiveness was the key however. The GTF reacted much too slowly.

There was a fear expressed that adoption of this system would bring about a change in doctrine. Voice communications are archaic. Most voice communication especially between officers, is wasted time. Voice will be needed as a backup.

In order to properly test this system, a stress filled amphibious situation is needed.

A standard format for briefing is needed. This should be stored in memory separate from the journals.

Tm 4: The FASC did not use the map background; the map background is not necessary; the grid lines, however, were necessary. The capability to selectively call up and display certain subsets of map information would be nice to have.

The S-2 did use the map background; it was necessary to do his job. Actually two different maps were needed by the S-2, and

the ability to display two different maps at the same terminal is required.

The S-3 did not use the map background because of clutter.

The S-2 wanted capability to gradually tone in or tone out the map background.

Not having voice communications was missed very much.

The S-2 wanted to operate the terminal himself without the operator.

The S-3 felt digital communication is less effective than voice and that voice communication is necessary. The flow of information to the companies is good digitally but the flow of information from the companies...

People may tend to rely on the system too much because of its convenience.

With voice communication you would prevent the feeling of being far removed from the actual combat situation. There is danger of a "fur lined foxhole" syndrome.

Brevity codes would be needed, even with digital communication, to reduce communication loads.

It was generally felt that by using the system they lost the "feel for the battle" and the people using the system would tend to get lazy, not do their homework, and rely on the system too much.

It was felt that a good COC system does not require graphics if the other capabilities were there.

The S-2 felt that the system gave the Battalion S-2 the opportunity to do intelligence work which more properly should be done at a higher level.

4. Issue: Would the FASC want to monitor 81 FO corrections? Why (not)?

Test Participants Responses, Observations, Comments.

Tm 1: Monitoring 81 mm adjustment is unnecessary.

Tm 2: Monitoring 81 mm adjustments is unnecessary.

Tm 3: The FASC has no need to monitor 81 mm fire adjustments.

Tm 4: The FASC did not miss or have any need to monitor 81 mm fire adjustings.

5. Issue: Were you able to effectively process calls for fire?

Test Participant Responses, Observations, Comments.

Tm 1: Yes.

Did not use map background at all for coordinating fire support. Map only needed for fire support planning. The symbology does not really indicate the location of a unit or its formation on the ground. This is confusing for coordinating fire support and renders the system untrustworthy.

All the information needed for fire support causes too much clutter when all displayed at once.

The ability to selectively call up and/or erase overlay items is a desired capability.

The FASC would like a fire support status board type display available.

Automated assisted targeting solely through interaction with the screen graphics is very much desired.

We must maintain an acetate map board.

Tm 2: Yes.

Ability to selectively call up graphic overlays is a definite need.

No unnecessary symbology, it was all needed.

Situation maps with acetate are also needed.

Grid lines are needed. Map background is not necessary. Unit location is a strong selling point. Clutter is a serious problem. One screen and a paper map would not suffice for the FASC.

The FASC needs two work stations and the ability to selectively call up graphic overlays immediately when needed.

Tm 3: Yes.

During the test, the FASC functioned well with only one terminal but felt he needed two because the scenario did not place a heavy burden on fire support. One terminal could easily become overburdened.

The FASC used two terminals interchangeably between different tasks in order to perform more than one function at the same time. He did not assign specific tasks to a particular terminal.

The FASC felt that the map background was unnecessary.

The FASC used grid lines on a white background because of symbol congestion. He did not use a map.

Ability to selectively and responsively call up and erase display information on the screen was very much desired by the FASC. Timely responsiveness was the key, however, the OTF reacted much too slowly.

Tm 4: Yes.

The reason the FASC needs so many terminals is because of the need to reduce symbology clutter. A secondary reason is to handle more missions than this scenario called for.

The FASC did not use the map background. The map background was not necessary; the grid lines however were necessary. The capability to selectively call up and display certain subsets of map information would be nice.

There is a need to reduce symbology clutter.

The FASC was impressed by gun target lines, mortar positioning visible on the screen and aircraft tracks.

6. Issue: Were you able to keep the companies informed as to items pertaining to their mission?

Test Participant Responses, Observations and Comments.

Tm 1: For the S-2 automation was big plus, particularly in the areas of message handling and data base lookup. A real situation would have triple the message traffic contained in the scenario.

Tm 2: A better information handling system is desperately needed. This may be the answer. It is not going to help command and control, very much, however.

We did not feel isolated from the battlefield.

Message handling and reliability were much, much better than the current system and is a vast improvement, even without the fancy graphics.

Tm 3: The S-2 was favorably impressed with flow of message traffic, as were the other participants. They all felt that the increased message handling ability was the most desirable aspect of the system. The graphs and PLRS are nice to have. This system will serve a great need if it can reduce "Comm" "rhetoric".

Such a multipurpose system as this should be made available to the S-1 and S-4.

In order to properly test this system, a stress-filled amphibious situation is needed.

Tm 4: The S-3 felt that digital communication is less effective than voice and that voice communication is necessary. The flow of information to the companies is good digitally but the flow of information from the companies is better by voice.

We really liked the rapid dissemination of information. We were easily able to keep the entire battalion advised.

The S-2 really liked the friendly real-time positioning information but wanted the ability to put his own graphical information on the screen. He feels that too much raw information (as opposed to intelligence) was sent to the battalion.

The S-3 would like to ha e the data base automatically adjust as casualty and ammo reports come in and give a warning when threshholds are reached.

With voice communication you would prevent the feeling of being far removed from the actual combat situation. There is danger of a "fur lined foxhole" syndrome.

Brevity codes needed, even with digital communication to reduce communication loads.

This sytem increases timeliness, thereby giving the S-2 more "think time" instead of busy work. As far as the S-2 is concerned, timeliness is all important. It was generally felt that by using the system they lost the "feel for the battle" and the people using the system would tend to get lazy, not do their homework, and rely on the system too much.

7. Issue: Was there effective coordination between the S-2, the S-3, and the FASC?

Test Participants Responses, Observations, Comments.

Tm 1: Since the S-3 normally outranks the S-2, if the terminal is shared, the S-2 would get very little time.

There are advantages to sharing a work station such as easier passing of information between the S-2 and the S-3, but the disadvantages far outweigh the advantages. In the defense, the S-2 will need his own work station.

Tm 2: Four work stations are needed. The S-2 and S-3 cannot work on the same system. The same is true for the defense. Situation maps with acetate are also needed. S-2 and S-3 sharing a console is totally unsatisfactory from the S-2's viewpoint.

Tm 3: The S-2 needs his own terminal.

Tm 4: If had to make do with only three terminals, the FASC would only get one terminal.

8. Issue: Would you rather fight with or without an automated COC?

Test Participant Responses, Observations, Comments.

Tm 1, 2, 3, 4: Rather have one available.

9. Issue: Survivability/Reliability

Test participant responses, observations, comments.

Tm 1: Survivability of the equipment is a serious concern.

Physical survivability and reliability is a major concern. Serious doubt exists as to the reliability of the system. Manual backup training will be a necessity for times when the system is down.

Tm 2: A manual backup will be needed. A kneeboard map will suffice. A voice communication system is needed as a backup.

A manual backup will definitely be needed.

We feel uneasy about the system reliability.

Tm 3: Other fears expressed were concerned with system survivability and detachment from the human agony of battle.

Reliability and survivability are suspect. Voice communication needed as a backup.

Tm 4: No reference made.

10. Issue: Personnel, Personnel Duties, Doctrine.

Test Participant Responses, Observations, Comments.

Tm 1: Some school kids using calculators never learn to multiply and divide. The same thing could happen to a battalion staff using the system.

The S-3 would still have to keep a log book.

Enlisted Marines at the battalion level do not have the GOT to operate such a system.

Given such an automated system, we would still need the manpower and resources to maintain an acetate map board.

Enlisted Marines at the battalion level can be trained to operate the system.

Tm 2: Situation maps with acetate are also needed.

Tm 3: Officers should operate the system, not enlisted. Watch officers could operate the machines. However, there would be no reduction in the number of CP personnel due to the myriad other tasks to be performed, including CP security. No additional people would be required because of the system. There was a fear expressed that adoption of this system would bring about a change in doctrine.

Tm 4: This automated system would not do away with any billets. The S-2 wanted to operate the terminal himself, without the operator. People may tend to rely on the system too much because of its convenience.

11. Issue. Map Boards, Displays, Color.

Test Participant Responses, Observations, Comments.

Tm 1: Given such an automated system, we would still need the resources to maintain an acetate board. The FASC would like a fire support status board type display available. He did not use map background at all for coordinating fire support. A map is only needed for fire support planning.

We did not use map background; too much clutter. We used grid lines.

Tm 2: Being restricted to one color is not that much of a factor. There was no unnecessary symbology, it was all needed. A manual backup will be needed. A kneeboard map would suffice. Situation maps with acetate are also needed.

Grid lines are needed, map background is not necessary. Clutter was a serious problem. One screen and paper map would not suffice for the FASC.

Tm 3: A Marine Corps-wide, computer brevity code would be needed with a system such as this. The FASC used grid lines because of clutter using a map. Such a multipurpose system as this should be made available to the S-1 and S-4.

Tm 4: We should provide additional systems for S-1 and S-4.

The FASC did not use map background, it is not necessary. Grid lines are necessary, however, as is the capability to selectively call up and display certain subsets of map information.

The S-2 did not use the map background.

The S-3 did not use the map background because of clutter.

The S-2 wanted the capability to gradually tone in or tone out the map background.

We would like to have the data base automatically adjust as casualty and ammo reports come in and give a warning when threshholds are reached.

Brevity codes will be needed even with digital communication to reduce communication loads.

12. Issue: Scenario Inadequacies, Defense versus Offense. Isolation from Battlefield.

Test Participant Responses, Observations. Comments.

Tm 1: Automation was perhaps of some use, but scenario was too limited to really tell.

A real situation would have triple the message traffic contained in the scenario.

The S-2 absolutely has to have a second screen in defense. More information is needed in the defense as opposed to the offense.

Tm 2: Number of work stations needed for defense will be the same as for the offense.

We did not feel isolated from the battlefield.

Tm 3: The scenario did not place a heavy burden on fire support, therefore, the FASC functioned well with only one terminal. More terminals would be needed in defense than in the offense. Three or two terminals could not handle a defensive situation.

In order to properly test the system, a stress-filled amphibious situation is needed.

Tm 4: The reason the FASC needs more terminals is to be able to handle more missions than the scenario called for.

With voice communication you would prevent the feeling of being far removed from the actual combat situation. There is danger of a "fur lined foxhole" syndrome.

We generally felt that by using the system we lost the "feel for the battle" and the people using the system would tend to get lazy, not do their homework, and rely on the system too much.

APPENDIX B

STATISTICAL ANALYSIS

NOTE: This Appendix presupposes a familiarization with "The Battalion COC GTF Validation Test Plan", MCTSSA Document No. 22TO01/U-TR-01 9 October 1981.

MOP 1a. (Proportion of Fire Support requests correctly handled)

The Type III Incomplete Latin Square yielded an F value of 1.3 (α=.44). The data was reorganized and the ANOVA was computed using test participant team as the treatment factor. The F value was 6.7 (α=.084).

In order to further explore the possibility of a learning effect, a t-Test was used to test the hypothesis that the correlation coefficient between the effectiveness measure and the order (1st, 2nd or 3rd) was equal to zero (Ref: "Statistics in Research", Ostle & Mensing, Iowa State University Press, 1975). For MOP 1a, this hypothesis could not be rejected (α<.1).

An iterative missing data technique was then used to estimate the missing items and yield a 4x4 design. A two-way randomized block ANOVA with work station mix and test participant team as treatment and block factors could then be conducted which had 5 denominator degrees of freedom. The resultant F values for work station mix and test participant team were 2.5 (α= .2) and 13 (α=.01), respectively.

MOP 1b. (Mean time to process 81 mm calls for fire)

For this MOP the Type III Incomplete Latin Square yielded an F value of 2.83 (α=.23).

Recasting the data and using test participant team as the treatment factor yielded an F value of .661 (α=.65). The t-Test on the correlation coefficient revealed no learning effect.

The next step was to compute a one-way ANOVA (8 denominator degrees of freedom) with work station mix as the treatment factor. The F value was 3.75 (α=.06). Scheffe's method for multiple comparisons was then used (Ref:

"Analysis of Variance", Guenther, Prentice-Hall, 1964). The only significant ($\alpha<.1$) two-way comparison was between Mixes C and D.

MOP 2. (Proportion of Combat Information Passed)

The Type III Latin Square yielded an F value of 1.3 ($\alpha=.45$). Using test participant team as the treatment factor yielded an F value of 2.5 ($\alpha=.24$). The t-Test on the correlation coefficient revealed no learning effect. A one-way ANOVA with work station mix as the treatment factor resulted in an F value of .39 ($\alpha=.76$).

MOP 3. (Proportion of Data Base Entries Made)

The Type III Incomplete Latin Square yielded an F value of 3.7 ($\alpha=.18$) for work station mix as the treatment and an F value of 24 ($\alpha=.02$) for test participant team as the treatment. Again the t-Test revealed no discernible learning effect. Estimating the missing values in a 4x4 design and computing a two-way randomized block ANOVA resulted in an F value of 1.8 ($\alpha=.27$) for work station mix and an F value of 11 ($\alpha=.01$) for test participant team.

MOP 4C. (Battlefield Perception Scores)

The test plan specified a two-factor, completely randomized, fixed effects ANOVA. The data and results were as follows:

		TEST PARTICIPANT BILLET			
		S3	S3A	S3	FASC
Work Station Mix	A	1, 2, 2	2, 2, 2	0, 2, 1	2, 1, 2
	B	2, 1, 2	2, 1, 2	2, 2, 2	2, 0, 2
	C	0, 2, 0	1, 2, 2	2, 1, 2	2, 0, 2
	D	1, 2, 2	2, 2, 2	2, 2, 0	1, 0, 2

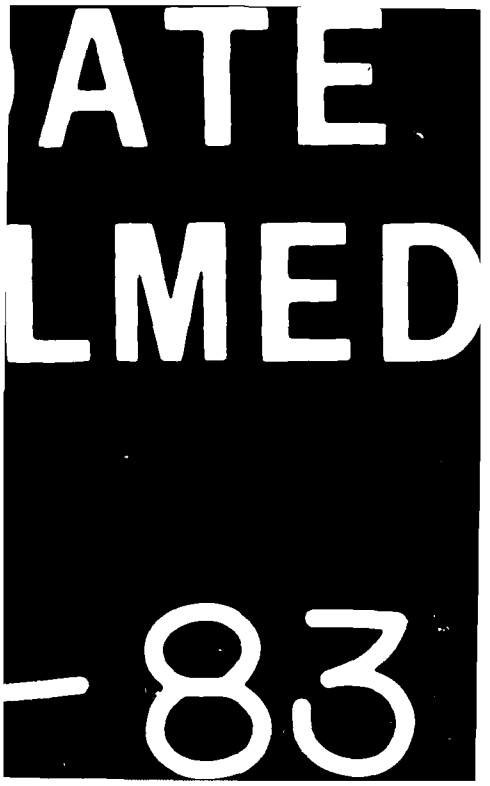
TWO-WAY

Source	SS	DF	MS	F	α
Mix	.729	3	.243	.402	.73
Billet	1.729	3	.576	.954	.47
Interaction	4.188	9	.465	.77	.65
Error	19.333	32	.604		
TOTAL	25.979				

ONE-WAY

Source	SS	DF	MS	F	α
Mix	.729	3	.243	.423	>.75
Error	25.25	44	.574		
TOTAL	25.979				

The scores for a single test participant team in a single iteration were then summed across the billets. The resultant 4x3 array (Table 3-5) was analyzed in the same manner as the first four MOPs. The Type III Incomplete Latin Square yielded an F value of .5 (α=.69) for test participant team and after rearranging the data yielded an F value of 1.6 (α=.39) for work station mix. The t-Test failed to reject the hypothesis of a zero correlation coefficient.


ATE
LMED
-83